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POLICY OPTIONS IN THE FACE OF POSSIBLE RISK FROM POWER FREQUENCY ELECTRIC AND MAGNETIC FIELDS (EMF)

Draft for Public Comment
April, 2001

DO NOT CITE OR QUOTE

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Policy Options in the Face of Possible Risk from Power Frequency Electric and Magnetic Fields (EMF)

ABSTRACT

In 1993 the California Public Utilities Commission (PUC) mandated that the Department of Health Services (DHS) oversee a program of research and policy analysis about power frequency EMFs. In addition to projects on EMF exposures in schools and the workplace and a study on EMFs and miscarriage, the program supported two policy analyses. They dealt respectively with possible EMF avoidance measures, on the power grid and in schools.

A stakeholders advisory group oversaw the EMF program. In overseeing the policy analysis it became clear that stakeholders operate under different policy frameworks that lead to differences in preferred action. For example, economists and regulators adhere to a "utilitarian" framework that aims at "the most good for the most people at the least cost," many citizens adhere to a "social justice" framework that aims at "protecting the most vulnerable regardless of cost" while others adhere to a framework that requires virtual certainty of a problem before acting on it. Still others adhere to a "non-interventionist" framework that prefers voluntary non-governmental approaches to environmental risk regardless of the degree of confidence that there is a problem.

To assist economists and regulators who frame policy in terms of costs and benefits the policy analysts asked, "how confident must one be that EMFs cause disease and how much disease must be caused before one could justify adopting cheap or expensive EMF avoidance measures?" The results suggest that inexpensive to expensive expenditures could be justified from a cost-benefit perspective even if one is not 100% confident that EMFs cause disease. Depending on the measures taken this could increase 1999 era utility rates between 0.2% to 3.5% for a decade and could cost $0.48 to $7.6 billion. Judging by other protective measures taken, economists have determined that society seems willing to pay $5 million per statistical death avoided. To make these investments cost beneficial economists would require that one avoid between 100 and 1500 deaths over the 35 year useful life of the modified power lines state wide.(The DHS contractor acknowledges uncertainty in costs and the way projects would be financed, so that these numbers could be higher by a factor of 2)

School EMF interventions could cost $40 to $50 million statewide. Therefore to make this investment cost beneficial economists would require that one avoid 10 deaths among the 5 million students and half a million staff over the 35 year useful life of the modified schools state wide.

For those who use a "social justice" policy framework that aims at protecting the vulnerable regardless of cost, the analyses discuss issues of interest to that perspective. For those who use a framework that requires virtual certainty of an EMF effect to take any action, the analyses and the risk evaluation (see below) provides them with the information they need to take a position. Adherents to the "non-interventionist" framework will find discussions of voluntary or informational strategies that could be taken.

Adherents to the "cost/benefit," "social justice" and "absolute certainty-required" policy frameworks will probably advocate different courses of action on the basis of these assessments and analyses. The PUC has administrative procedures to resolve such differences with regard to power grid policy. They can use the information that the California EMF Program has gathered with regard to the power grid in any such deliberations. The state agencies and local districts concerned with educational facilities can use the policy analysis and exposure information in any policy activities that they pursue. DHS will not be making any recommendations on policy at this time but welcomes comments on this policy options document and DHS public comment draft Risk Evaluation (April 2001).

THE CALIFORNIA EMF PROGRAM

In 1993, the PUC directed investor owned utilities to provide funds for policy relevant research and public education. Municipal utilities contributed as well to this $7 million program. The resulting California EMF Program was fiscally implemented by the non-profit Public Health Institute (PHI) and directed by DHS. At the request of the PUC, a stakeholder's group including concerned citizens, the International Brotherhood of Electrical Workers, utilities, and various public interest groups advised DHS on the research topics to pursue and provided detailed comment on two policy projects. The projects supported by the EMF Program are described in the body of the report. Stakeholders asked the Department to carry out a risk evaluation in a way that would be helpful for forming policy in the face of uncertainty. A Science Advisory Panel of scientists without conflict of interest or particular biases about the EMF issue provided external criticism of the Risk Evaluation.

At the same time in 1993 the PUC directed investor owned utilities to follow a "no and low cost" EMF avoidance policy in constructing new transmission and

distribution lines, allowing them to charge rate payers for up to 4% of the total project cost in avoiding EMFs. They also directed the utilities to provide yearly updates on EMF research in one monthly bill per year and to provide free EMF measurements to their customers.

Four Policy Frameworks Lead to Different Courses of Action under Uncertainty

Members of the scientific community are far from unanimous as to their degree of confidence that EMFs influence the risk of various diseases. Making policy in the face of uncertainty is characteristic of many public health issues. Global warming, mad-cow disease, and irradiated foods come readily to mind as examples. In the course of designing and critiquing the program's school and power grid policy projects, it became clear that stakeholders have different policy frameworks that they use in approaching such problems. It also became clear that many arguments about policy choices are really arguments about frameworks. Economists, engineers, and regulatory agencies often use a predominantly results oriented "utilitarian" framework. Any given stakeholder using this framework considers his/her options along a number of criteria and chooses the option that produces the best trade-offs between the various criteria. In order to find the option with the best balance of criteria, the utilitarian stakeholder may assign dollar values to tangible criteria such as project costs and to intangible criteria such as aesthetic consequences or human lives saved. When different stakeholders using this approach end up advocating different courses of action because they have different interests, the utilitarian resolves the conflict by choosing the solution that aims at producing the "most good for the most people at the least cost." Sometimes this ignores the interests of some small segment of society. On many issues, members of the general public do not adhere to the utilitarian framework. Often they adhere either to a "social justice" framework that tries to fulfill duties or protect rights of the vulnerable regardless of cost, a "non interference" framework that tries to protect individual and property rights from governmental interference, or a framework that requires virtual certainty of a problem before taking action. Adherents to the different frameworks might prefer different policy options. For example, suppose a municipality that owned its own electrical utility decided that it was probable that magnetic fields from power lines and appliances were hazardous and wanted to do something about it. The utilitarians in town might recommend that the municipal utility should pay for the most cost-effective measures to reduce exposure, even if not deriving from the sources for which they are responsible. For example, they could buy up enough old, high-exposure electric blankets and replace them with new, low-exposure models, to prevent as much disease as might be caused by the power grid. The adherents to the social justice framework might point out that the minority of people living next to the power grid were still at unequal risk. They might invoke a strong form of the "precautionary principle" that expensive avoidance policies are warranted even if a few credible scientists suspect a small risk that violates the rights of even a small group of people. They might say there was a special duty to protect this group if it had been unfairly singled out for EMF or other harmful exposure on the basis of race, or had less access to medical care. From this perspective environmental agents like EMF should be treated as "guilty until proven innocent." Therefore the people living near the lines should be protected by modifying the lines to lower fields even if it was more expensive to do so. They might also invoke a duty of the utilities "to clean up their own mess" at their expense. The adherents to "non interference" might oppose both options because they involved involuntarily taxing the many for the benefit of the few. Regardless of the degree of confidence in the existence of an EMF hazard, they might prefer a "right to know" information program to allow the free market and voluntary actions of those who were concerned to solve the problem. Adherents to the "virtual-certainty-required" framework would not want to take any action unless all scientists in the field were totally convinced of a problem. For them EMFs are "innocent until proven guilty." There is no technical resolution to these kinds of arguments. A democracy handles them through the political process.

Policy contractors to the California EMF program were instructed to use an approach that would be useful to adherents of all frameworks and to highlight issues where the different policy frameworks might clash so that decision-makers could be helped to anticipate how features of different policy options might be attractive to stakeholders who adhered predominantly to one or the other policy framework. The "social justice," the "non-interference," and the "virtual-certainty required" frameworks are governed by fairly straightforward prescriptive principles and do not require extensive presentations. Their arguments are easier for most stakeholders to grasp. The results oriented utilitarian analysis by its nature requires extensive discussion of the potential consequences and costs of each option under consideration. Because of this, to be responsive to the utilitarian stakeholders and regulators, the bulk of the analyses are utilitarian and may be difficult for many stakeholders to follow. It is not the role of DHS at this point of the process to advocate for any one of these four policy frameworks.

In forming policy about the ubiquitous exposures from electricity, policy makers need to decide ahead of time if they will be considering issues of cost and if they would take action based on any degree of confidence about an EMF hazard less than 100%. For those who ignore costs or only act if there is virtual certainty of a hazard, substantial parts of the policy projects supported by the California EMF

program will not be helpful. For those who do consider these issues, the policy analysis should be helpful.

The decision analysis approaches used in the policy projects accommodates the non-utilitarian policy frameworks to the extent that they allow stakeholders to keep track of and take account of who pays for avoidance, and who gets the unusual exposures. It also deals explicitly with uncertainties.

The Economist's Approach to the Value of Public Health Action

Asking about the dollar value of a statistical life, as economists do, only makes sense from the utilitarian policy framework, which is willing to put dollar values on various criteria like human lives. Since many important stakeholders use this framework we address it head on, although stakeholders who use the social justice framework would feel uncomfortable even asking the question and stakeholders using the virtual-certainty-required framework would be uncomfortable being asked to pay for inexpensive measures that are warranted by degrees of confidence short of 100%.

The program's policy contractors reviewed the economic (utilitarian) literature that compares various medical, public health, and environmental policies and their efficacy to infer what economists think that society is willing to pay to avoid a statistical death. This varies from program to program, but $5 million per death avoided is close to the average for these various programs.

As a rough indicator of the health benefit that would be needed by the utilitarian framework to justify the cost of various avoidance measures, economists would divide the unit project cost (e.g., the per mile cost of undergrounding a 69 kV line) by $5 million per death avoided. This derives the deaths that an economist would require to be avoided per mile to make the unit project cost "cost-beneficial." We present the "unfinanced" base case project cost numbers of our policy contractors. The reports themselves discuss stakeholder arguments about these and other factual matters. The figures could easily be higher by a factor of 2. We also present the statewide project costs both as whole numbers and, for the power grid discussion, as fractions of the statewide utility revenues prior to the 2000/2001 California energy crisis.

Some economists would suggest that the stream of mortality be discounted to reflect the fact that some would do more to avoid an imminent death than they would to avoid a death 35 years in the future. To make the calculations transparent and because some oppose discounting statistical deaths, we have presented (the smaller) undiscounted numbers. These issues are discussed in the reports themselves. The numbers presented below allow the reader to determine the number of people "exposed" in the state and whether or not the avoidance measures require an implausibly large health benefit to warrant their adoption under the economist's utilitarian cost/benefit framework.

The Power Grid

Transmission lines are the high voltage, high current lines that run (usually on metal towers) from generators to substations and from substation to substation. There are about 1700 "corridor" miles of 69kV to 230 kV transmission lines that run through California residential areas with about 1.5 million people living within 500 feet on either side of these lines and 510,000 individuals living close enough to these lines to be substantially exposed to their magnetic fields (time weighted average (TWA greater than 2mG). A milliGauss (mG) is a unit of magnetic field exposure. A typical residence would convey an average exposure between 0.5 and 1 mG.

The inexpensive measures for lowering fields that are sometimes possible on the different voltage transmission lines (reverse phasing, optimum phasing and split phasing) vary a lot, but average out to costing about $80,000 a mile. So, dividing $80,000 per mile cost by $5 million per death avoided gives 0.016 deaths per mile over the 35-year lifetime of a transmission line (or 27 deaths {undiscounted} along all 1700 miles). If this "inexpensive" measure ($136 million total) could avoid these deaths, economists would say that it would pay for itself. The impact on utility rates for a decade would be a fraction of a percent.

The expensive measure for lowering fields from transmission lines is to underground the lines and configure them in ways more possible when underground so that the magnetic fields cancel. The calculations for this are shown in Table 1

There are 160,000 miles of above ground primary distribution lines in California leading (usually on wooden poles) from substations to customers. About 4.2% are estimated to be in residential areas and to also produce fields of the sort in the "high" category of epidemiological studies. Thus some 6,700 miles of distribution lines are possible candidates for retrofitting on the basis of EMF exposure. Our contractor estimates that 1 million individuals live close enough to these lines to be substantially exposed by their magnetic fields (TWA greater than 2 mG).

The inexpensive but quite efficacious means of canceling magnetic fields that is sometimes possible with distribution lines is achieved by arranging the wires in a

"compact delta" configuration. The results of the calculations for these are also shown in Table 1.

For distribution lines, the expensive measure is to underground them and configure the circuits so that the magnetic fields cancel. See Table 1 for the calculations for this measure.

Perhaps 5% of people live in homes with substantially elevated magnetic fields from neutral current returning to the grid along plumbing rather than the neutral wire. This is calculated to affect 550,00 homes and 1.65 million people to the extent that fields in those homes average above 2 mG.

The measure recommended for lowering this exposure is to insert a non-conductive (usually plastic) segment of pipe to force the current back to the neutral wire. This might cost $200 to $500 per home. See Table 1 for the calculations.

The EMF exposures to the public from generating stations and substations would be negligible except for the transmission and distribution lines that enter and leave them. These other sources have been described above.

As can be seen in Table 1, about 1.51 million Californians receive average EMF residential exposures greater than 2mG from the power grid and another 1.65 million receive such exposures within their homes from the way neutral currents return to the grid via plumbing instead of the neutral lines. Since there are overlaps between these sources the total exposed is less than the sum of these numbers. Except for selected occupational groups, residential exposures account for most of the daily exposures because most people spend so much time at home during the 24-hour day. The moderate cost measures of rephasing transmission lines, compacting distribution lines, and modifying plumbing would cost about $0.48 billion state wide, increasing utility rates for a decade by less than 1%. One would need to avoid about 98 (undiscounted) deaths statewide over a 35-year period to make these measures seem cost beneficial to an economist. The expensive measure of undergrounding residential area transmission lines and the of distribution lines that produce high EMF exposures along with the modest cost of altering plumbing in houses with neutral return problems would cost about $7.6 billion and would raise utility rates by about 3.5% for a decade. One would need to avoid about 1500 (undiscounted) deaths over 35 years to make this measure seem cost beneficial to an economist.

TABLE 1. RESIDENTIAL EMF SOURCES, THE COSTS OF MODERATE AND EXPENSIVE MITIGATION, AND THE REQUIRED DEATHS TO AVOID TO SEEM COST BENEFICIAL FOR ECONOMISTS

EMF SOURCE AND MITIGATION	RESIDENTIAL POPULATION "AFFECTED" TWA>2 MG	AMOUNT	MODEST COST MEASURES (REPHASING AND COMPACTING LINES)				EXPENSIVE MEASURES (UNDERGROUNDING)			
			UNIT COST	TOTAL COST	% OF 10 YEAR REVENUE	STATEWIDE DEATHS TO AVOID IN 35 YEARS TO JUSTIFY COSTS [1]	UNIT COST	TOTAL COST	% OF 10 YEAR REVENUE	STATEWIDE DEATHS TO AVOID IN 35 YEARS TO JUSTIFY COSTS [1]
Transmission	510,000	1,700 miles	$80,000 per mile	$136 million	0.06 %	27	$1.46 million per mile	$2.48 billion	1.13 %	495
Distribution	1 million	6,700 miles	$35,000 per mile	$234.5 million	0.11%	47	$750,000 per mile	$5.03 billion	2.3 %	1,005
Grounding	1.65 million	550,000 homes	$200 per home	$110 million	0.05%	22	$200 per home	$110 million	0.05 %	22
Total	2.59 million*			$480.5 million	0.22 %	96		$7.61 billion	3.46 %	1,522

[1] By dividing total cost by $5 million per death avoided, a utilitarian would derive the number of avoided deaths required to make a measure cost beneficial

* The total number of exposed people is smaller than the sum of people affected by each source, because of an overlap between sources.

Schools

Table 2 shows similar calculations for the four sources that account for 80% of the exposures in California schools according to a survey of 89 randomly selected schools carried out for the California EMF program. The most common source is the misconnecting of neutral lines in the breaker box. This leads to a condition called "net currents." This wiring practice is contrary to the electrical code and can increase the probability of fires. It also produces magnetic fields. It is not very expensive to change, but many schools have at least one classroom affected. Proximity to electrical panels is a rare source that requires expensive shielding to deal with. Distribution lines and transmission lines are much less frequent sources of exposure next to schools and can be dealt with as described above. The program's contractors estimate that the total cost of a statewide program to deal with these four sources would be around $43 million. A big element of statewide cost would be the systematic survey of EMF exposure in all 8,000 schools to detect unusual sources. The row totals are not always the sum of the numbers in the cells because not all schools have all sources.

The economist would require that one would need to avoid 9 deaths among the 5 million students and among the half a million teachers over a 35-year period to make these measures cost beneficial.

The bulk of EMF exposure expressed as "milliGauss-hours" is below 2 mG. Hence, the measures in Table 2 aimed at eliminating exposures above 2 mG only eliminate a fraction of the exposure. There is some epidemiological evidence that risk only begins to accrue above 3-4 mG.

TABLE 2. COSTS OF MEETING A 2-MG STANDARD FOR THE SPATIALLY-AVERAGED MAGNETIC FIELD IN CLASSROOMS. COSTS ARE BEST ESTIMATES, BASED ON UNIT COST ESTIMATES AND EXPOSURE DATA IN ZAFFANELLA AND HOOPER 2000. ACTUAL COSTS MAY DIFFER SIGNIFICANTLY FROM THESE ESTIMATES.

	SOURCE				
	NET CURRENTS ONLY	ELECTRICAL PANELS ONLY	DISTRIBUTION LINES ONLY	TRANSMISSION LINES ONLY	ALL FOUR
Cost per affected school	$5,300	$37,000	$30,000	$65,000	$13,000
Number of affected schools	~ 3,000	~ 300	~ 300	~ 200	~3,500
Statewide total costs	$16 million	$12 million	$9 million	$13 million	$43 million
Statewide deaths to avoid to be cost beneficial at $5 million/death	3.2	2.4	1.8	2.6	9
Statewide costs, not including survey	$8 million	$4 million	$8.3 million	$12.8 million	$33 million
Statewide survey costs	$8 million	$8 million	$0.7 million	$0.2 million	$10 million
Fraction of statewide school-time EMF exposure eliminated	20%	1%	4%	3%	29%

DETAILED DECISION ANALYSIS INSIGHTS

Stakeholders pointed out to the policy analysts that direct project construction costs and potential health benefits were not the only criteria by which to compare the status quo to the inexpensive options and the expensive options. Particularly with regard to the all important power grid, stakeholders argued about how the several options would impact reliability, loss of power due to resistance, and property values. It also became clear that the way any changes were financed (pay as you go vs. borrow and pay interest) was important. Another 20 considerations, including tree-cover, avoided pole collisions, impact on air pollution, and electrical fires, were considered but turned out to involve far less costs than the first listed items. Their consideration thus did not affect the ranking of options. A report and computer models were prepared for distribution lines and various voltage classes of transmission lines, as well as for changing the grounding system to avoid ground currents. These models allowed consultants for the various stakeholders to challenge assumptions made and satisfy themselves that the insights gained were valid. A similar approach was used for the School Policy Analysis.

The reader should refer to the summaries and full reports of the actual projects for the full set of conclusions, but in general both the power grid and the school policy analyses concluded that there were inexpensive to moderately expensive measures that could be justified on a cost-benefit basis if there was a moderate degree of confidence that childhood leukemia alone was affected by EMFs. However, expensive measures would not be justified even by a 100% degree of confidence of a quite strong effect on this disease alone. A moderate degree of confidence that EMFs contributed to the cause of several diseases would warrant expensive measures. Three assigned scientists, a physician/epidemiologist, a geneticist/epidemiologist, and a physicist with training in epidemiology assessed the relevant literature with the assistance of ten other DHS scientists. The reader can see from the Risk Evaluation that, prior to considering the specific evidence about EMFs, the scientists started with a low degree of confidence that every day exposures to EMFs would cause disease. After reviewing the EMF evidence this degree of confidence increased. Although the three scientists did not always agree, they concurred that EMFs were " more than 50% likely" to be a cause of childhood leukemia, adult brain cancer, Lou Gehrig's disease and miscarriage. Lesser but moderate degrees of confidence of causality for adult leukemia, male breast cancer, sudden cardiac death and suicide were expressed by these scientists. Based on the current evidence they had uniformly low degrees of confidence that EMFs caused other reproductive and developmental problems like birth defects or that EMFs were universal carcinogens. Since even the lowest risks detectable by epidemiologists imply lifetime risks greater than 1 per 100,000, even the associations with the rarest diseases would be of regulatory interest if real. Nonetheless, the absolute individual risks of EMF exposure would be so low that the odds of contracting these diseases are extremely low even for highly exposed people. Even if only a few percent of the annual background California deaths from conditions that received degrees of confidence greater than 50% was due to EMFs {childhood leukemia (99) adult brain cancer (1294), Lou Gehrig's disease (434)} this could be sufficient to exceed the 98 deaths over 35 years needed to make modest changes to the power grid cost beneficial over a 35 year period. The same could be said for the 9 deaths over 35 years that would be required to make changes in schools cost beneficial.

Policy Implications

The Department is not making recommendations at this time, particularly since the Risk Evaluation carried out by three of the scientists working for DHS has not completed its public comment period. The interested public is referred to the power grid and school policy analysis projects, which deal with various topics. These include inexpensive or expensive avoidance measures on the power grid and in schools and the cost effectiveness of further research.

The policy projects do not deal with all the issues that might be of interest to the public. Some of these include:

- Continuing or not continuing the PUC policy of no and low cost avoidance in new projects, providing yearly bill stuffers on EMFs and free EMF measurements for customers
- Whether or not to permit leasing rights of way under transmission lines, the siting of tot lots and jogging paths near transmission lines, changing amperage on existing transmission towers, logging currents on transmission lines to facilitate further study
- Training and certification of those who might test schools for EMFs or do electrical contracting work there
- Options for other types of buildings such as office buildings, hospitals , day care centers, nursing homes, factories
- Options and public information about EMFs in electrical rail transit and electrical or hybrid automobiles
- Options for electrical and other occupations

- Options for providing education and technical assistance to government agencies and the public

- Options for the design of appliances or for building codes

- The role (if any) of conservation and of solar and wind power and "distributed generation" in reducing the amount of electricity used and the distance it must travel

- The oversight, organization and funding of any further research, and topics for further policy relevant research (if any) such as studies of the relative reliability of above and below ground power lines, the occurrence of electrocutions along the power grid, and further studies of common health conditions thought to be associated with EMFs

- Options for implementing any actions so that they are or are not sensitive to fairness and issues of environmental justice

From the utilitarian cost benefit perspective, the degree of confidence about causality for the various diseases considered would suggest that a number of inexpensive and moderate cost measures could be justified for adoption.

On the basis of the Risk Evaluation, adherents to the various policy frameworks may advocate different courses of action. Adherents to the social justice framework may well advocate more expensive or wide reaching measures. Adherents to the "virtual certainty required" framework may advocate no action at this time, while adherents of the" non-interference" framework may advocate informational approaches only.

The PUC has administrative procedures for reconciling conflicting interests and perspectives with regard to the power grid. This is particularly important in the face of the need in California for more capacity in generation and transmission of electricity. State and local agencies develop policy for schools. Since electricity is so ubiquitous many agencies have potential interest in this issue.

A conscientious utilitarian would ask if there were an even more cost beneficial use to which scarce resources could be put. For example, if moneys spent on rephasing or undergrounding transmission lines were spent on anti-smoking education, could one obtain more benefit from the same money? The policy analysis contractors point out that there are "decision domains" across which money cannot flow. The PUC is unlikely to authorize the investor owned utilities to spend rate payer money on smoker education, so that question is not realistic. It would be legitimate to ask if the utilities would provide more health benefit by spending money to generate electricity with less sulfur and nitrates for acid rain, less CO_2 for global warming or less mercury for environmental contamination. The California EMF program is unable to answer the utilitarian framework questions comparing EMF avoidance with other possible health promoting policies of the utilities since comparable cost benefit analyses of these other issues have not been done. In any case, the non-utilitarian policy frameworks might use different principles to judge the relative usefulness of EMF avoidance versus avoiding these other problems.

Risk Communication and Implications for Other EMF Decisions

The program paid for a detailed analysis related to the power grid and to public schools, but electricity is ubiquitous and central to society in developed countries. By taking any action with regard to the power grid and or schools, policy-makers would send a message about the need to make changes in the design of appliances, commercial and public buildings, electrical transportation and workplace standards. While the risk assessment shows that the vast majority of individuals would not be affected by EMFs, there could well be anxiety generated by mandated avoidance action in the school, power grid, and home grounding sectors. Anxiety itself has health consequences. There is also the possibility of tort lawsuits in the various sectors where electricity is used and EMF exposure occurs. These legitimate concerns are raised when any new environmental regulation is proposed. For example, there were major concerns raised about such issues when Proposition 65 was adopted in the mid 1980s requiring the labeling of products that contained recognized carcinogens and reproductive toxicants. Now, more than a decade later, many of the original fears about the regulation are seen to have been exaggerated. Experience has shown that people tend to take a "better safe than sorry" approach to even very small risks, if there is no benefit to them personally and the exposure is involuntary. However people will often tolerate risks and not be anxious if there is cost to them to remove the exposure or benefit from tolerating it. Therefore it will be important to provide information to the public and to develop stakeholder agreement on how to proceed with regard to EMF exposures.